CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A method, comprising:

forming calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$) into a briquette a pressure greater than 14 megapascal (MPa);

calcining the briquette;

transforming the calcium sulfate dihydrate briquette to a calcium sulfate hemihydrate ($CaSO_4 \cdot ½ H_2O$) [alpha-type] ("alpha-hemihydrate") briquette; and

drying the alpha-hemihydrate briquette.

2. The method of claim 1, further comprising grinding the dried alpha-hemihydrate briquette.

3. The method of claim 2, wherein the ground alpha-hemihydrate has a bimodal particle size distribution.

4. The method of claim 1, further comprising:

coarsely grinding the dried alpha-hemihydrate briquette; and

subsequently fine grinding the dried alpha-hemihydrate.

5. The method of claim 1, further comprising:

grinding the dried alpha-hemihydrate briquette into a powder; and

mixing the powdered alpha-hemihydrate with water.

6. The method of claim 1, further comprising:

grinding the dried alpha-hemihydrate briquette into a powder; and

mixing the powdered alpha-hemihydrate with water and fly ash.

7. The method of claim 1, wherein the volume of the calcium sulfate dihydrate briquette is approximately 0.125 to 125 cubic inches.

8. The method of claim 7, wherein the calcination time ranges from about 30 minutes to six hours to substantially complete the transformation of the calcium sulfate dihydrate to the alpha-hemihydrate.

9. The method of claim 7, wherein the calcination time ranges from about 30 minutes to 2.5 hours.

10. The method of claim 7, wherein the calcination time ranges from about one to two hours.

11. The method of claim 1, wherein the volume of the calcium sulfate dihydrate briquette is approximately 1 to 27 cubic inches.

12. The method of claim 11, wherein the calcination time ranges from about 30 minutes to six hours to substantially complete the transformation of the calcium sulfate dihydrate to the alpha-hemihydrate.

13. The method of claim 1, wherein the volume of the calcium sulfate dihydrate briquette is approximately 1 to 8 cubic inches.

14. The method of claim 13, wherein the calcination time ranges from about 30 minutes to six hours to substantially complete the transformation of the calcium sulfate dihydrate to the alpha-hemihydrate.

15. The method of claim 1, wherein the pressure used to form the calcium sulfate dihydrate briquette ranges from greater than 14 to about 500 megapascal (MPa).

16. The method of claim 15, wherein the calcination time ranges from about 30 minutes to six hours to substantially complete the transformation of the calcium sulfate dihydrate to the alpha-hemihydrate.

17. The method of claim 1, wherein the pressure used to form the calcium sulfate dihydrate briquette ranges from about 50 to 320 MPa.

18. The method of claim 17, wherein the pressure used to form the calcium sulfate dihydrate briquette ranges from about 100 to 200 MPa.

19. The method of claim 17, wherein the pore volume of the alpha-hemihydrate briquette is approximately 30 to 49% of the total volume of the briquette.

20. The method of claim 17, wherein water comprises from approximately 0% to 12% by weight of the calcium sulfate dihydrate briquette.

21. The method of claim 17, further comprising:

coarsely grinding the dried alpha-hemihydrate briquette; and

subsequently fine grinding the dried alpha-hemihydrate;

wherein the ground alpha-hemihydrate has a bimodal particle size distribution.

22. The method of claim 1, wherein the pore volume of the alpha-hemihydrate briquette is approximately 30 to 49% of the total volume of the briquette.

23. The method of claim 1, wherein the pore volume of the alpha-hemihydrate briquette is approximately 40 to 49% of the total volume of the briquette.

24. The method of claim 1, wherein water comprises from approximately 0% to 12% by weight of the calcium sulfate dihydrate briquette.

25. The method of claim 1, wherein water comprises from approximately 1% to 5% by weight of the calcium sulfate dihydrate briquette.

26. The method of claim 1, wherein water comprises approximately 2% to 3% by weight of the calcium sulfate dihydrate briquette.

27. A ground alpha-hemihydrate made from the process of claim 2.

28. A product produced from a mixture comprising:

ground alpha-hemihydrate made from the process of claim 2; and

water.

29. The product of claim 28, further comprising sand.

30. The product of claim 28, further comprising fly ash.

31. A calcium sulfate hemihydrate ($CaSO_4 \cdot ½ H_2O$) [alpha-type] ("alpha-hemihydrate") comprising:

crystals of the alpha-hemihydrate that have grown together to form clusters of the crystals;

wherein the clusters of crystals have substantially reduced pore volume between the clusters, than the pore volume of alpha-hemihydrate crystals formed from dihydrate briquettes compressed at pressures less than or equal to 14 megapascal (MPa).

32. The alpha-hemihydrate of claim 31, wherein the clusters of crystals may be ground to produce blocky crystals of alpha-hemihydrate.

33. The alpha-hemihydrate of claim 32, wherein the ground alpha-hemihydrate has a bimodal particle size distribution.

34. The alpha-hemihydrate of claim 31, wherein the substantially reduced pore volume comprises a pore volume of about 30 to 50% of the volume of the crystals.

35. The alpha-hemihydrate of claim 31, wherein the substantially reduced pore volume comprises a pore volume of about 40 to 50% of the volume of the crystals.

36. A dry, ground calcium sulfate hemihydrate ($CaSO_4 \cdot ½ H_2O$) [alpha-type] ("alpha-hemihydrate") converted from a calcined calcium sulfate dihydrate briquette that was compressed at a pressure of greater than 14 megapascal (MPa); wherein the dry, ground alpha-hemihydrate has a water demand of less than 50 milliliters (ml) per 100 grams (g) of dry, ground alpha-hemihydrate.

37. The alpha-hemihydrate of claim 36, wherein the alpha-hemihydrate is formed from gypsum obtained as a byproduct from at least one of the following processes: desulfurization of flue gases, production of titanium dioxide, or production of phosphate fertilizers.

38. The method of claim 36, wherein the pressure used to form the calcium sulfate dihydrate briquette ranges from about 100 to 200 MPa.

39. The method of claim 38, wherein water comprises from approximately 0% to 12% by weight of the calcium sulfate dihydrate briquette.

40. The method of claim 39, wherein the volume of the calcium sulfate dihydrate briquette is approximately 1 to 27 cubic inches.